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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/975,297	10/12/2001	Viatcheslav V. Ossipov	10007286-1	1278

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EXAMINER

SOWARD, IDA M

ART UNIT PAPER NUMBER

2822

DATE MAILED: 08/22/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

09/975,297

Applicant(s)

OSSISOV ET AL.

Examiner

Ida M Soward

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-- **Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --**
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 June 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 21-33 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 and 21-33 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>5</u> . | 6) <input type="checkbox"/> Other: |

DETAILED ACTION

This office action is in response to the Applicant's amendment filed 6/17/02.

Priority

This application filed under former 37 CFR 1.60 lacks the necessary reference to the prior application. A statement reading "This is a division, continuation, etc. of Application No. 09/974,808, **filed 10/12/01.**" should be entered following the title of the invention or as the first sentence of the specification. Also, the current status of all nonprovisional parent applications referenced should be included.

Specification

The objection to the disclosure has been withdrawn due to the amendment filed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-6, 14 and 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084) in view of Kusunoki et al. (US 2001/0017515 A1).

van Gorkom et al. teach an electron emitter comprising: a p region **3** formed of a semiconductor material having a hole concentration of 10^{19} cm^{-3} ; a dielectric layer **6** formed above the p region; an Al metallic layer **8** formed above the dielectric layer; a substrate **2** below the p region; and a p electrode **10** formed above and making electrical contact with the p region (Figures 2-3, cols. 6-7, lines 20-49 and 31-44, respectively). However, van Gorkom et al. fail to teach a means for emitting electrons through a metallic layer. Kusunoki et al. teach a means for emitting electrons through a metallic layer (Figure 1, pages 4-1, paragraphs [0063], [0065] & [0073]). Kusunoki et al. further teach at least one voltage biasing source is connected such that the electrons tunnel through a dielectric layer **12** prior to passing to the metallic layer. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al. with the means for emitting electrons of Kusunoki et al. decrease the power consumption of the device.

Claims 7, 23 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084) and Kusunoki et al. (US 2001/0017515 A1) as applied to claims 1 and 21 above, and further in view of Koh et al. (US 2002/0033536 A1).

van Gorkom et al. and Kusunoki et al. (US 2001/0017515 A1) teach all mentioned in the rejection above. However, van Gorkom et al. and Kusunoki et al. (US 2001/0017515 A1) fail to teach an M electrode above and making contact with a metallic layer. Koh et al. teach an M electrode **11** above and making contact with a

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metallic layer **10** (Figure 1). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al. and the means for emitting electrons of Kusunoki et al. with the electrode and metallic layer of Koh et al. to eliminate a leakage current path.

Claims 8, 13, 24 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084) and Kusunoki et al. (US 2001/0017515 A1) as applied to claim 1 above and further in view of Palara (5,665,994).

van Gorkom et al. and Kusunoki et al. (US 2001/0017515 A1) teach all mentioned in the rejection above. However, van Gorkom et al. and Kusunoki et al. (US 2001/0017515 A1) fail to teach an n⁺ region formed above a substrate such that a p region is formed within the n⁺ region. Palara teaches an n region **12** formed above a substrate **10** such that a p⁺ region **20** is formed within the n region (Figure 5). Palara further teaches an n electrode **6** formed above and making electrical contact with an n⁺ region **17** (Figure 5). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al. and the means for emitting electrons of Kusunoki et al. with the p and n regions of Palara to provide a compact integrated device.

Claim 9 and 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gorkom et al. (4,325,084), Kusunoki et al. (US 2001/0017515 A1) and Palara

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(5,665,994) as applied to claim 1 and 8 above, and further in view of Suzuki et al.

(5,329,141).

Gorkom et al., Kusunoki et al. and Palara teach all mentioned in the rejection above. However, Gorkom et al., Kusunoki et al. and Palara fail to teach an electron concentration level of an n region greater than a hole concentration level in a p region. Suzuki et al. teach an electron concentration level of an n region greater than a hole concentration level in a p region (col. 5, lines 31-35). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al., the means for emitting electrons of Kusunoki et al. and the p and n regions of Palara with the concentrations of Suzuki et al. to achieve an effective flow of electrons.

Claims 10 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084), Kusunoki et al. (US 2001/0017515 A1) and Palara (5,665,994) as applied to claims 1, 8, 21 and 24 above, and further in view of Morishita (5,140,400).

van Gorkom et al., Kusunoki et al. and Palara teach all mentioned in the rejection above. However, van Gorkom et al., Kusunoki et al. and Palara fail to teach an n⁺ region formed from materials with wider band gap than a p region. Morishita teaches an n⁺ region formed from materials with wider band gap than a p region (col. 10, lines 16-37). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al., the means for

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emitting electrons of Kusunoki et al. and the p and n regions of Palara with the n+ wider band gap of Morishita to prevent undesired diffusion current.

Claims 11 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084), Kusunoki et al. (US 2001/0017515 A1) and Palara (5,665,994) as applied to claims 1, 21 and 24 above, and further in view of Bronner et al. (US 6,242,770 B1).

van Gorkom et al., Kusunoki et al. and Palara teach all mentioned in the rejection above. However, van Gorkom et al., Kusunoki et al. and Palara fail to teach a p region thickness less than a diffusion length of non-equilibrium electrons in the p region. Bronner et al. teach a p region thickness of 0.05 μm to about 0.2 μm , which is less than a diffusion length of non-equilibrium electrons in the p region (col. 5, lines 5-15). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al., the means for emitting electrons of Kusunoki et al. and the p and n regions of Palara with the p region thickness of Bronner et al. to occupy a lesser wafer area.

Claims 12 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084), Kusunoki et al. (US 2001/0017515 A1) and Palara (5,665,994) as applied to claims 1, 8 and 21 above, and further in view of Ishio et al. (US 200/0014705 A1).

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van Gorkom et al., Kusunoki et al. and Palara teach all mentioned in the rejection above. However, van Gorkom et al., Kusunoki et al. and Palara fail to teach a metallic layer thickness on the order of or less than a mean free path for electron energy. Ishio et al. teach a metallic layer thickness of 3nm to 1 μ m which is on the order of or less than a mean free path for electron energy [0095]. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al., the means for emitting electrons of Kusunoki et al. and the p and n regions of Palara with the metallic layer thickness of Ishio et al. to ensure high connection reliability.

Claims 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084) and Kusunoki et al. (US 2001/0017515 A1) as applied to claims 1 and 21 above, and further in view of Song (6,153,014).

Gorkom et al. and Kusunoki et al. teach all mentioned in the rejection above. However. Gorkom et al. and Kusunoki et al. fail to teach a dielectric breakdown field of $1.5 * 10^7 \leq F_b \leq 2 * 10^7$ V/cm. Song teaches a dielectric breakdown field of $1.04 * 10^7$ V/cm (col. 7, lines 7-11). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al. and the means for emitting electrons of Kusunoki et al. with the dielectric breakdown field of Song to provide a uniform layer.

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Claim 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over van Gorkom et al. (4,325,084) and Kusunoki et al. (US 2001/0017515 A1) as applied to claims 1-6, 14 and 21-22 above, and further in view of van Gorkom et al. (Journal of Vacuum Science and Technology).

Gorkom et al. and Kusunoki et al. teach all mentioned in the rejection above. However, Gorkom et al. and Kusunoki et al. fail to teach at least one voltage biasing source electrically connected to a n+ region (Figure 1). Also, it is within the level of ordinary skill to interchange the potential on a device. Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the structure of van Gorkom et al. and the means for emitting electrons of Kusunoki et al. with the voltage biasing source of van Gorkom (Journal of Vacuum Science and Technology) to provide a device with high current densities.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents are cited to further show the state of the art with respects to electron emitters:

Baliga et al. (5,679,966)

Hipwood (4,633,279)

Mishra (5,077,597)

Sasaguri (US 2001/0020733 A1)

Schnitzler (3,845,296)

Shannon et al. (3,931,633)

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Shannon et al. (4,516,146)

Strite (5,952,680)

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Response to Arguments

Applicant's arguments with respect to claims 1-14 and 21-33 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ida M. Soward whose telephone number is 703-305-3308. The examiner can normally be reached on Monday - Friday, 7:30 am to 4:00 pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

ims
August 19, 2002


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800